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Research Article

An Assessment on the Students' Level of Earthquake Awareness and Preparedness on "The Big One"

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Abstract: Since the Philippines has been subjected to numerous seismic events throughout the past several decades, it is only prudent to be aware and prepared for what will unavoidably happen when the Marikina West Valley Fault System moves. The study aims to assess the College of Science students' earthquake awareness and preparedness level, an essential part of their understanding of proper response and management in natural disasters. It will also allow the community and the environment to establish necessary precautions. A descriptive-survey study approach was applied to assess the level of awareness and preparedness of 160 respondents from all year levels from the College of Science at Bulacan State University. Results show that most respondents are highly aware and prepared for an earthquake. However, low levels were shown in some components of earthquake public awareness and disaster risk reduction preparedness. This includes the respondents' contingency plan awareness, security of household materials, and coordination with local government units regarding potentially high-risk objects. A significant difference was also seen in the respondents' awareness of the existing contingency plan and participation in first-aid training for risk reduction. In addition, first-year students mainly acquired their awareness from School/Office, while second- to fourth-year students acquired it mainly from the Internet. With the obtained results, the authors created a proposed intervention consisting of programs regarding the university's Incident Command System, Contingency Plan, and Disaster Risk Reduction Management.

Keywords: Contingency Plan; Disaster Risk Reduction Management; Incident Command System; Marikina West Valley Fault.

1. Introduction

An earthquake is a sudden, violent ground disturbance caused by energy discharge from the earth's outermost layer or volcanic activity. Major earthquakes initiate many surface processes that persist over a brief period of severe trembling. Most moderate- and large-magnitude seismic events trigger landslides, ranging from minor ruptures in the ground cover to enormous and devastating landslides [1], [2]. It exhibits a range of magnitudes, from imperceptible tremors to catastrophic events, which often result in substantial losses and life damage, contingent upon the scale and duration of seismic activity [3], [4]. The most predominant cause of seismic activity is the movement of various fault systems or numerous fractures within the earth's surface. Earthquakes are considered one of the most catastrophic and terrifying all-natural disasters. Natural disasters are predisposed to destroy and hinder vulnerable households in persistent poverty [5]–[8].

One of the notable regions of faults where most volcanic eruptions and earthquakes happen is the Circum-Pacific Belt, frequently referred to as the Pacific Ring of Fire. A vast structure of active volcanoes and seismic systems surrounds the Pacific Ocean surface [9]–[11]. The chain

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traverses throughout the westernmost regions of North and South America. It passes the Aleutians Island chain in Alaska, towards the eastern coast of the Asia-Pacific region and Northern Antarctica. About the study of [12], the area is a segment of the earth that comprises many active volcanoes and earthquake points. This geographical area represents seventy-five percent of global volcanic activity, where a significant portion is situated beneath the surface of water bodies. In comparison, ninety percent of the most prominent quakes emerge within the area. In an analysis by [13], the Philippine archipelago sits among Asia's most seismically vulnerable areas. Having a large portion of the country's islands situated along the Pacific Ring of Fire, the Philippines has been subjected to numerous catastrophic volcanic and seismic events over the years [14]–[16].

An illustrative instance is the 1990 Luzon Earthquake, which impaired the entire Luzon Island at 4:26 PM on July 16, 1990. The seismic event was calculated to have reached a magnitude of 7.7 with a maximum intensity scale of 9. It produced a ground rupture spanning 125 kilometers, which stretches from the Municipality of Dingalan in Aurora to Kayapa in the province of Nueva Vizcaya. The incident prompted significant property damages, including the collapsing of numerous structures, with a total estimated monetary loss of $369 million. Unfortunately, the disaster also ended with the tragic loss of 2,412 individuals.

Apart from contributing detrimental damage to society, earthquakes can also give rise to Earthquake Environmental Effects (EEE). Such effects include tsunamis, surface faulting, ground resonance, soil liquefaction, ground failure, and landslides. These natural occurrences can be associated with the earthquake source or caused by tremors beneath the earth. The negative ecological consequences of catastrophic earthquakes are likely to be broad due to seismic shaking and tectonic deformation [17]. The parameters that constitute the earthquake causing the effects and the inherent features of the affected media determine the magnitude and scope of specific effects [18], [19].

The Philippines is in the middle of preparations for a potentially devastating earthquake identified as "The Big One," which might happen at any moment. The Big One is anticipated to attain a high-intensity, 7.2 magnitude earthquake. It has been forecasted that the Marikina West Valley Fault (MWVF), which spans 100 kilometers and traverses seven major cities in Metro Manila and neighboring provinces, will be the origin of the impending earthquake in the region [20]. In recent years, various International and Philippine Government Agencies have published numerous studies and records regarding the location of the MWVF. The government continually emphasizes this fault system's significance and has requested assistance through various entities and organizations. According to eclectic research findings, the MWVF is an enormous fault system running throughout Central and Southern Luzon areas. The structure of this fault exhibits alarming seismological activity and can trigger high-magnitude scenarios at a frequent rate. The MWVF passes over the eastern parts of the Manila Metropolitan region and portions of the provinces within Bulacan, Laguna, Cavite, and Rizal [21]. According to the Philippine Institute of Volcanology and Seismology, it has been identified that the last movement of the fault was in 1658, which was 359 years ago. As stated by [22], it was noted that this particular fault generally moves approximately 200 to 400 years.

Following the findings of Topacio et. al, urban areas within the valley fault system have been identified as areas with high population density [23]. The regions where the fault line is present encompass major infrastructures and high-rise buildings. The locations above are widely acknowledged as the primary business hubs of the country. These include the Ortigas Center, located in the western part of Pasig City, Tiendesitas, along the C-5 road, and sizable billboards in Ugong Pasig City, among other establishments. Consequently, a substantial segment of the nation's economy depends on these areas. In the event of an earthquake, certain areas may become uninhabitable, considering the presence of the MWVF system.

2. Material and Methods

2.1. Research Design

The researchers utilized a Descriptive Research design in conducting this study. According to [24], [25], descriptive research methods are commonly used in education, nutrition, epidemiology, and behavioral sciences, in which research data can be obtained through observation, analysis, and description. This utilizes research instruments such as questionnaires, personal interviews, phone surveys, and normative surveys. Survey analysis employs data collection techniques, including questionnaires containing various items that reflect the research's purpose [12]. This design provides factual values and emphasizes appropriate subjects that must be evaluated.

2.2. Respondents and Sampling Method

The study participants were selected from the student's total population of the College of Science at Bulacan State University. The researchers utilized the Systematic Random Sampling method (1) with a 95% confidence level and 5% margin of error, which uses a skipping pattern selection that is applied to determine the number of respondents. Systematic sampling is a research procedure defining

various processes in which each sample is selected from the population by taking a specific number of items until the desired sample size is reached [26]. Furthermore, according to [27], Systematic Random Sampling is a simple probability sampling in which every nth from the random start is selected. Thus, in selecting respondents, each student has an equal chance to be chosen as part of the sample. The respondents comprised 40 students from 1st year, 40 from 2nd year, 40 from 3rd year, and 40 from 4th year, with a total sample size of 160 students. This suggested that enough respondents were calculated to represent the target of the study.

$$n = \frac{Z^2PQ}{1 + \frac{1}{N}\left(\frac{Z^2PQ}{d^2} - 1\right)} \quad (1)$$

In order to calculate the sample size in systematic random sampling, the formula nsys = nsrs x 0.50 was used. In addition, the researchers provided a list of the population of the chosen respondents, which was arranged according to their respective college programs.

$$k = \frac{N}{n} \quad (2)$$

The skipping pattern used in the selection was computed using the formula below (2), where N is the total population and n is the sample size. The calculated regular interval (k) for the first-year students was 12, while k=11 for the second-year students, k=9 for the students from the third year, and k=12 for the fourth-year students. The skipping patterns from each year level were applied until the number of respondents was reached.

Table 1. The Population of College of Science Students.

Courses Bachelor	1st Year	2nd Year	3rd Year	4th year	Total
Biology	113	151	84	110	458
Environmental Science	35	36	37	38	146
Food Technology	72	85	52	49	258
Mathematics	257	171	191	292	911
Total	477	443	364	489	1173
Sample Size	40	40	40	40	160

2.3. Instruments

The researchers constructed a Likert scale-based research questionnaire to see the earthquake awareness and preparedness level of College of Science Students at Bulacan State University. It comprised the student's academic profile and was divided into three criteria, including ten items of a 4-point Likert scale on I. Public Awareness Questionnaire, six items of a 10-point Likert scale on II. Earthquake Environmental Effects Awareness Questionnaire and ten items of 4-point Likert scale on III. Risk Reduction.

The researchers also prepared a multiple-response questionnaire consisting of 7 possible answers on IV. They have acquired Earthquake Awareness and Preparedness Information (Sources of Information). The said components of the questionnaire underwent a validity and reliability test. The Public Awareness Questionnaire showed a mean expert proportion of 1.0, implying acceptable value, and a Cronbach alpha (α) of α=.818, indicating good internal consistency. The Earthquake Environmental Effects Questionnaire displays a mean expert proportion of 1.0, implying an acceptable value, with a Cronbach alpha (α) of α=.904, indicating excellent internal consistency.

Furthermore, the Risk Reduction Questionnaire displayed a mean expert proportion of 1.0, implying acceptable value, and a Cronbach alpha (α) of α=.760, indicating acceptable internal consistency. Lastly, the Acquired Earthquake Awareness and Preparedness Information Questionnaire showed a Cronbach alpha (α) of α=.760, indicating good internal consistency. Also, a high degree of reliability was found in the questionnaire. The ICC average measure showed a value of .810 (High Consistency) with a 95% confidence interval from .684 to .898 (F (29,174) = 5.256, p<.000), which is highly significant.

2.4. Data Collection Procedure

The researchers requested the approval of the College of Science OIC-Dean to ask for permission to gather data from their college. The researchers provided A letter of consent, assuring that the respondents' information, including the demographic profile, would remain confidential. After approval, waivers of the participants were signed, and the researchers administered the questionnaire to the respondents. Each item was explained to ensure the validity of the collected data. The handling of questionnaires is done personally by the researchers and facilitated by the retrieval of responses. Subsequently, the results from the questionnaire were tallied and encoded to proceed with analyzing the gathered data.

2.5. Data Processing and Statistical Treatment

The researchers measured the outcome by surveying Public Awareness, Earthquake Environmental Effects Awareness, and Disaster Risk Reduction. These indicators are neither exhaustive nor measured precisely, giving a relative idea of how the respondents know the following earthquake parameters. To present and examine the data collected in this study, the following statistical tool was used:

a. Weighted Mean - To find the total average responses of the College of Science students on each question.
b. Grand Mean - To find the total average responses of the College of Science students each year.

The researchers employed the following scale with corresponding verbal interpretation. For Public Awareness and Disaster Risk Reduction questionnaire:

Table 2. Scale for Measuring the Public Awareness and Disaster Risk Reduction Awareness.

Range	Numerical Rating	Verbal Interpretation
3.25 - 4.00	4	Strongly Agree
2.50 - 3.24	3	Agree
1.75 - 2.49	2	Disagree
1.00 - 1.74	1	Strongly Disagree

This scale is useful in quantitatively assessing public attitudes and awareness, particularly in the context of disaster risk management and reduction. For Earthquake Environmental Effects Awareness Questionnaire:

Table 3. Scale for Measuring the Earthquake Environmental Effects Awareness.

Range	Numerical Rating	Verbal Interpretation
10.00	10	High
9.00	9	High
8.00	8	High
7.00	7	Almost High
6.00	6	Moderate
5.00	5	Moderate
4.00	4	Low
3.00	3	Low
2.00	2	Low
1.00	1	Low

Kruskal Wallis Test - The Kruskal Wallis Test was used to determine if there are significant differences between all the College of Science year levels.

Table 4. Scale for Measuring the Significance Between Public Awareness, Earthquake Environmental Effects Awareness, and Risk Reduction Preparedness.

Range	Verbal Interpretation
P<0.05	There is a significant difference
p>0.05	There is no significant difference

3. Result and Discussion

Table 5 shows the descriptive statistics of the respondents' public awareness from the first year to the fourth year of College of Science Students at Bulacan State University. Statement number 1, which is "I have proper knowledge about what an earthquake is." has a weighted mean of 3.55 for the first year, which signifies Agree, 3.78 for the second year, which means Agree, 3.65 for the third year, which indicates Agree, and 3.75 for the fourth year which implies Agree.

Table 5. Descriptive Statistics of the Respondents' Public Awareness.

Public Awareness	1st year	2nd year	3rd year	4th year
1. I have proper knowledge about what an earthquake is.	3.55	3.78	3.65	3.75
2. I know an existing fault line in the areas within Mega Manila called the West Valley Fault.	3.30	3.28	3.28	3.35
3. I am aware that the West Valley Fault is active.	3.33	3.20	3.18	3.20
4. I know I am near or within the West Valley fault system.	3.05	2.98	2.78	3.20
5. I know the Philippines lies within the Pacific Ring of Fire.	3.58	3.73	3.70	3.65
6. I am aware of the different intensity levels of earthquakes.	3.45	3.45	3.68	3.60
7. I am aware of the different magnitudes of earthquakes.	3.50	3.45	3.65	3.60
8. I know the possible destructive earthquake named the Big One that could happen inside the Pacific Ring of Fire parameters.	3.38	3.63	3.58	3.50
9. I am aware that there is an existing Incident Command System.	2.58	2.48	2.60	2.50
10. I am aware that there is an existing Contingency Plan.	2.08	2.68	2.80	2.60
Grand Mean	3.18	3.26	3.29	3.30

Statement number 2, which is "I am aware that there is an existing fault line in the areas within Mega Manila called the West Valley Fault." has a weighted mean of 3.30 for the first year, which signifies Agree, 3.28 for the second year and third year which means Agree, and 3.35 for the fourth year which indicates Agree. Moreover, statement number 3, which is "I am aware that the West Valley Fault is an active fault." has a weighted mean of 3.33 for the first year, which signifies Agree, 3.20 for the second year, and the fourth year, which means Agree, and 3.18 for the third year which indicates Agree. Statement number 4, which is "I am aware that I am near or within the West Valley fault

system." has a weighted mean of 3.05 for the first year, which signifies Agree, 2.98 for the second year, which means Agree, 2.78 for the third year which indicates Agree, and 3.20 for the fourth year which implies Agree. In addition, statement number 5, "I am aware that the Philippines lies within the Pacific Ring of Fire." has a weighted mean of 3.58 for the first year, which signifies Agree, 3.73 for the second year, which means Agree, 3.70 for the third year which indicates Agree, and 3.65 for the fourth year which implies Agree. Statement 6, "I am aware of the different intensity levels of earthquakes." has a weighted mean of 3.45 for the first year and second year, which signifies Agree, 3.68 for the third year, which means Agree, and 3.60 for the fourth year, indicating Agree.

Furthermore, statement number 7, which is "I am aware of the different magnitudes of earthquakes." has a weighted mean of 3.50 for the first year, which signifies Agree, 3.45 for the second year, which means Agree, 3.65 for the third year which indicates Agree, and 3.60 for the fourth year which implies Agree. Statement number 8, which is "I am aware of the possible destructive earthquake named the Big One that could happen inside the Pacific Ring of Fire parameters." has a weighted mean of 3.38 for first year, which signifies Agree, 3.63 for second year which means Agree, 3.58 for third year which indicates Agree, 3.50 for fourth year which implies Agree.

Additionally, statement number 9, which is "I am aware that there is an existing Incident Command System." has a weighted mean of 2.58 for the first year, which signifies Agree, 2.48 for the second year, which means Disagree, 2.60 for the third year which indicates Agree, and 2.50 for the fourth year which implies Agree. Lastly, statement number 10, which is "I am aware that there is an existing Contingency Plan." has a weighted mean of 2.08 for the first year, which signifies Disagree, 2.68 for the second year, which means Agree, 2.80 for the third year which indicates Agree, and 2.60 for the fourth year which implies Agree. In total, public awareness of the respondents has a grand mean of 3.18 for the first year, which signifies Agree; 3.26 for the second year, which means Agree; 3.29 for the third year, which indicates Agree; and 3.30 for the fourth year, which implies Agree.

Table 6. Descriptive Statistics of the Respondents' Earthquake Environmental Effects Awareness.

Earthquake Environmental Effects Awareness	1st year	2nd year	3rd year	4th year
I have an adequate understanding regarding the possible Earthquake Environmental impacts such as:				
1. Surface Faulting o *pagkakaroon ng bitak sa lupa.*	9.08	9.03	8.80	9.48
2. Tsunami *o pagragasa ng isang malaking alon sa kalupaan.*	8.68	8.88	9.28	9.48
3. Soil Liquefaction o paglambot ng lupa.	8.48	8.45	8.85	9.18
4. Ground Resonance o *pagyanig ng lupa at mga establisyemento.*	9.10	9.03	8.98	9.53
5. Landslides o *pagguho ng lupa mula sa kabundukan.*	9.20	9.33	9.23	9.53
6. Ground Failure o *pagbagsak ng malaking parte ng kalupaan.*	8.83	8.73	9.03	9.28
Grand Mean	8.89	8.90	9.03	9.41

Table 6 illustrates the Earthquake Environmental Effects Awareness of the respondents. From the statement, "I have an adequate understanding regarding the possible Earthquake Environmental impacts such as:" Surface Faulting o *pagkakaroon ng bitak sa lupa*." The first-year students have a weighted mean of 9.08, while the second-year students show a weighted mean of 9.03, 8.80 for third-year students, and 9.48 for fourth-year students. All year level indicates a high Earthquake Environmental Effects Awareness regarding "Surface Faulting o *pagkakaroon ng bitak sa lupa*." Furthermore, in the second statement "Tsunami o *pagragasa ng isang malaking alon sa kalupaan*." First-year students show an 8.68 weighted mean, 8.88 for second-year students, 9.28 for third-year students, and 9.48 for fourth-year students.

All respondents indicate a high Earthquake Environmental Effects Awareness regarding statement number two. On statement number three, "Soil Liquefaction o *paglambot ng lupa.*" First-year students show a weighted mean of 8.48, 8.45 for second-year students, 8.85 for third-year students, and 9.18 for fourth-year students, indicating high. Moreover, in number four statement "Ground Resonance o *pagyanig ng lupa at mga establisyemento*." First-year students show a weighted mean of 9.10, 9.03 for second-year students, 8.98 for third-year students, and 9.53 for fourth-year students, indicating high. In the fifth statement "Landslides o *pagguho ng lupa mula sa kabundukan*." First-year students reveal a 9.20 weighted mean average, second-year students reveal a 9.33 weighted average, a 9.23 weighted average for third-year students, and a 9.53 weighted average for fourth-year students; all respondents reveal high in this statement. Lastly, "Ground Failure o *pagbagsak ng malaking parte ng kalupaan*." or the statement number 6. First-year students indicate 8.83, second-year students have an 8.73 weighted mean, third-year students reveal a weighted mean of 9.03, and fourth-year students have a 9.28 weighted mean, all revealing a high. The table reveals that the grand mean of the first-year students is 8.89; on the other hand, second-year students have a grand mean of 8.90, 9.03 grand mean

for third-year students, and fourth-year students show 9.41 grand mean.

Table 7. Descriptive Statistics of the Respondents' Risk Reduction.

Disaster Risk Reduction	1st year	2nd year	3rd year	4th year
1. My house/building is well-designed to withstand an earthquake.	2.78	2.75	2.58	2.70
2. I already bolted and strapped heavy objects to prevent them from falling when an earthquake strikes.	2.43	2.40	2.35	2.43
3. I keep toxic chemicals inside a secured area to prevent spillage.	3.10	2.95	3.03	3.00
4. I ensure all electrical wiring and outlets are safe and secure.	3.10	3.10	3.05	3.20
5. I ensure all flammable and explosive materials are hidden in a safe place.	3.35	3.00	3.15	3.30
6. I coordinated all risky posts and trees to the local government unit.	2.75	2.45	2.33	2.70
7. I participated in some first-aid training.	3.23	2.83	2.65	2.78
8. I can apply the safety procedures during earthquake drills.	3.30	3.25	3.13	3.20
9. I am familiar with and fully aware of the evacuation plan within my area.	3.03	2.98	2.93	2.98
10. I regularly check all my water pipes to prevent leakage and bursting.	2.63	2.70	2.50	2.63
Grand Mean	2.97	2.84	2.77	2.89

Table 7 displays the Disaster Risk Reduction Questionnaire; the respondents from the first year have a weighted mean of 2.78 for the first statement, which is that "My house/building is well-designed to withstand an earthquake.", while the second-year respondents resulted in a weighted mean of 2.75, the third-year respondents have a weighted mean of 2.58, and a weighted mean of 2.70 for the fourth-year respondents. This signifies that most respondents agree that their residency areas can withstand earthquakes. For the second statement, which is, "I already bolted and strapped heavy objects to prevent them from falling when an earthquake struck.", the first-year students show a weighted mean of 2.43, 2.40 for second-year students, 2.35 for third-year students, and 2.43 for the fourth-year students which all implies Disagree. The results for the second statement inferred that most respondents agreed on taking actions to prevent heavy objects from falling in case of an earthquake, except for the first- and third-year students. The third statement, "I keep toxic chemicals inside a secured area to prevent spillage." had a weighted mean of 3.10 for the first-year students, 2.95 for the second-year students, 3.03 for the third-year students, and 3.00 for the fourth-year students. Most respondents agree with keeping a safe place for toxic chemicals in their area.

Moreover, the weighted mean from first-year to fourth-year students for statement 4 is relatively close: 3.10, 3.10, 3.05, and 3.20, respectively. This result from the fourth statement shows that they agree that they make sure that the electrical wirings and outlets are safe and secure to use. The fifth statement is, "I ensure that all flammable and explosive materials are hidden in a safe place." There is a weighted mean of 3.35 for the first-year students, 3.00 for the second years, 3.15 for the third-year students, and 3.30 for the respondents from the fourth year. This implies that they also agree with the aforementioned fifth statement. The sixth statement states, "I coordinated all risky posts and trees to the local government unit." The first-year students showed a weighted mean of 2.76, while the fourth-year students obtained 2.70, implying Agree. However, second-year students showed a weighted mean of 2.45, while third-year students got 2.33, indicating disagreement. As for the weighted mean among the first-year to fourth-year students in the seventh statement, "I participated in some first-aid training.", it ranges from 2.65 to 3.23, with the third-year respondents having the lowest and the first-year respondents having the highest mean. This indicates that the first-year students mostly agreed to participate in first-aid training. On the eighth statement, which is "I can apply the safety procedures that are done during earthquake drills.", the first-year respondents have a weighted mean of 3.30, the second-year respondents have a weighted mean of 3.25, the third years have a weighted mean of 3.13, and the fourth-year respondents having a weighted mean of 3.20. The values are very close to each other, indicating that the respondents from the College of Science students agree and strongly agree with applying safety procedures during earthquake drills. For the ninth statement: "I am familiar and fully aware of the evacuation plan within my area.", the first-year respondents have the highest weighted mean, which is equivalent to 3.03, while the weighted mean for the second-year students is 2.98, as well as the fourth-year students having the similar weighted mean.

In comparison, the third-year students have a weighted mean of 2.93. The results from the ninth statement reveal that most respondents agree with their awareness of the evacuation plan in their respective areas. Lastly, for the tenth statement, "I regularly check all my water pipes to prevent leakage and bursting.", the first-

year respondents have a weighted mean of 2.63, 2.70 for the second-year students, the highest. While the mean of the third-year students is 2.50, the lowest, and the weighted mean for the fourth-year students is 2.63. This shows that almost all respondents agree to check their area's water pipes to prevent leakage regularly. In summary, for the Risk Reduction Questionnaire, the results revealed that the first-year students have the highest gained mean, 2.97, while the third-year students have the lowest weighted mean, 2.77, among all the College of Science respondents. This suggests that the first-year students agree the most with the questions about risk reduction in line with earthquake awareness and preparedness.

Table 8. Comparing the Kruskal Wallis Test Results for Public Awareness.

Public Awareness	Kruskal-Wallis H	df	Asymp. Sig.
1. I have proper knowledge about what an earthquake is.	3.993	3	0.262
2. I know an existing fault line in the areas within Mega Manila called the West Valley Fault.	0.733	3	0.865
3. I am aware that the West Valley Fault is active.	1.633	3	0.652
4. I know I am near or within the West Valley fault system.	4.978	3	0.173
5. I know the Philippines lies within the Pacific Ring of Fire.	0.194	3	0.979
6. I am aware of the different intensity levels of earthquakes.	2.649	3	0.449
7. I am aware of the different magnitudes of earthquakes.	1.002	3	0.801
8. I know the possible destructive earthquake named the Big One that could happen inside the Pacific Ring of Fire parameters.	1.756	3	0.624
9. I am aware that there is an existing Incident Command System.	0.602	3	0.896
10. I am aware that there is an existing Contingency Plan.	16.368	3	0.001

Table 8 shows the differences between the Public Awareness of College of Science students' year level. The first statement, "I have proper knowledge about what an earthquake is." shows a value of p=.262, indicating no significant differences between all year levels. From the second statement, "I am aware that there is an existing fault line in the areas within Mega Manila called the West Valley Fault." It has a value of p=.865, indicating no significant differences between all year levels. Additionally, the third statement, "I am aware that the West Valley Fault is an active fault." shows a value of p=.652, revealing no significant differences between all year levels. In the fourth statement, "I am aware that I am near or within the West Valley fault system." It shows a value of p=.173, showing no significant differences between all year levels.

Furthermore, the fifth statement, "I am aware that the Philippines lies within the Pacific Ring of Fire." reveals a value of p=.979, indicating no significant differences between all year levels. The sixth statement, "I am aware of the different intensity levels of Earthquake." means a value of p=.449, specifying no significant difference in all year levels. The seventh statement, "I am aware of the different magnitudes of earthquakes." shows a value of p=.801, indicating no significant differences in all year levels.

Moreover, the eighth statement reveals no significant differences in all year levels, offering a value of p=.624. The ninth statement, "I am aware that there is an existing incident Command System." reveals a value of p=.896, implying no significant difference in all year levels. However, the tenth statement, "I am aware that there is an existing Contingency Plan." has a value of p=.001, revealing a significant difference in all levels.

Table 9. Comparing the Kruskal Wallis Test Results for Earthquake Environmental Effects.

Earthquake Environmental Effects Awareness	Kruskal-Wallis H	df	Asymp. Sig.
I have an adequate understanding regarding the possible Earthquake Environmental impacts such as:			
1. Surface Faulting o *pagkakaroon ng bitak sa lupa*.	3.595	3	0.309
2. Tsunami o *pagragasa ng isang malaking alon sa kalupaan*.	5.404	3	0.145
3. Soil Liquefaction o *paglambot ng lupa*.	3.429	3	0.33
4. Ground Resonance o *pagyanig ng lupa at mga establisyemento*.	3.251	3	0.355
5. Landslides o *pagguho ng lupa mula sa kabundukan*.	1.237	3	0.744
6. Ground Failure o *pagbagsak ng malaking parte ng kalupaan*.	1.749	3	0.626

The results from Table 9 show the Earthquake Environmental Effects Awareness level of the respondents in the College of Science and its statistically significant differences to all year levels. From the first scenario regarding surface faulting o *pagkakaroon ng bitak sa lupa*, the p-value is 0.309, implying no significant differences in their level of awareness between all year levels. Meanwhile, in the second question about their awareness of tsunami o *pagragasa ng isang malaking alon sa kalupaan*, p=0.145. This also means there are no significant differences between first- and fourth-year students in their responses to the second scenario in the questionnaire. The third question, about soil liquefaction o *paglambot ng lupa*,

showed no further significant differences for all year levels with a p-value of 0.330.

Moreover, the p-value resulted in 0.355 for the fourth situation, which involves the ground resonance o *pagyanig ng lupa at mga establisyemento*. In line with this, there are also no significant differences from all year levels in their responses on the fourth situation. The result on the fifth situation on this part of the questionnaire is about landslides o *pagguho ng lupa mula sa kabundukan* is p=0.744, which implies that there is also no statistically significant difference from all year levels. Lastly, the sixth situation, the ground failure o *pagbagsak ng malaking parte ng kalupaan*, resulted in a p-value of 0.626, indicating no further significant differences in all year levels. Therefore, all the p-values from the Kruskal Wallis Test in the Earthquake Environmental Effects Awareness Questionnaire revealed no statistical differences in all year levels since all the equivalent p-values are less than 0.05.

Table 10. Comparing the Kruskal Wallis Test Results for Risk Reduction Preparedness.

Disaster Risk Reduction	Kruskal-Wallis H	df	Asymp. Sig.
1. My house/building is well-designed to withstand an earthquake.	2.479	3	0.479
2. I already bolted and strapped heavy objects to prevent them from falling when an earthquake strikes.	0.179	3	0.981
3. I keep toxic chemicals inside a secured area to prevent spillage.	0.762	3	0.858
4. I ensure all electrical wiring and outlets are safe and secure.	1.778	3	0.62
5. I ensure all flammable and explosive materials are hidden in a safe place.	6.476	3	0.091
6. I coordinated all risky posts and trees to the local government unit.	7.439	3	0.059
7. I participated in some first-aid training.	10.94	3	0.012
8. I can apply the safety procedures during earthquake drills.	2.15	3	0.542
9. I am familiar with and fully aware of the evacuation plan within my area.	0.502	3	0.918
10. I regularly check all my water pipes to prevent leakage and bursting.	1.186	3	0.756

Based on the results shown in Table 10 concerning the Risk Reduction Questionnaire, the p-value for the first question states that "My house/building is well-designed to withstand an earthquake." resulting in p=0.479. This signifies that no significant differences were identified from all year levels from their responses to the first question. Additionally, the p-value for the second question is equivalent to 0.981, implying no significant differences among all levels in line with the statement, "I already bolted and strapped heavy objects to prevent them from falling when an earthquake strikes." For the third question, "I keep toxic chemicals inside a secured area to prevent spillage, "p=0.858 also shows no significant differences. In the following question, which states, "I make sure that all electrical wirings and outlets are safe and secured.", the p-value resulted in 0.620, showing no significant differences in their responses from all year levels.

Moreover, the p=0.091 for fifth question, which is "I make sure that all flammable and explosive materials are hidden in a safe place." The value also implies no significant differences among all year levels' responses. From the result in the sixth statement, "I coordinated all risky posts and trees to the local government unit.", p=0.059 indicates no further significant differences on all year levels. However, the seventh question, "I participated in some first-aid training." resulted in a p-value of 0.012, less than 0.05; hence, it suggests significant differences among all year levels in the College of Science. As for the eighth question, "I can apply the safety procedures that are done during earthquake drills, "the p-value is 0.542, revealing no significant differences on all year levels. The p-value for the ninth question is equivalent to 0.918, which shows no greater significant differences from all year levels in line with the statement: "I am familiar and fully aware of the evacuation plan within my area." Finally, the last question, "I regularly check all my water pipes to prevent leakage and bursting." resulted in a p-value of 0.756, which denotes no significant differences among all the year levels. In summary, almost all the p-values in the Risk Reduction Questionnaire are less than 0.05 except for the seventh question regarding participation in first-aid training.

Table 11. Descriptive Statistics of Acquired Earthquake Awareness and Preparedness Information.

Sources of Information	Number of Students
Television	37
Radio	8
Print Media	12
Internet	38
Government Campaigns	15
School/Office	39
Family/Friends	23

Table 11 illustrates the descriptive statistics of the acquired earthquake awareness and preparedness information, such as the source of information of first-year

College of Science students at Bulacan State University. The number of students who acquired awareness and preparedness information through television is 37. On the other hand, eight students acquired awareness and preparedness information through Radio. Additionally, 12 students answered print media, and 38 answered the Internet. Moreover, 15 students got information from the government campaign, while 39 got theirs from school or office. Lastly, the number of students whose source of information is their family or friends is 23.

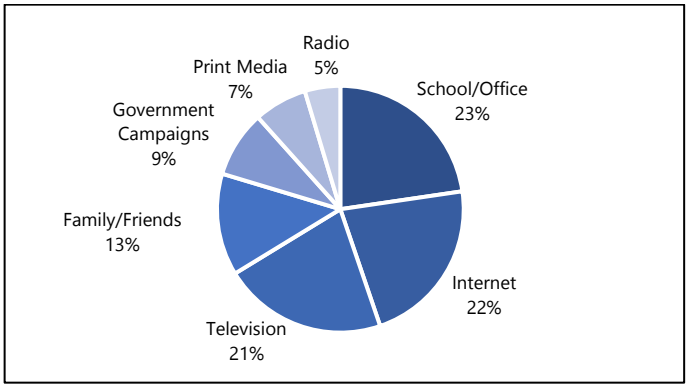

Figure 1. Pie chart of Acquired Earthquake Awareness and Preparedness Information.

Figure 1 reveals the percentage of acquired awareness and information of the 40 first-year respondents with 100%. The highest source with 23%, is acquired from School/Office; 22% acquired awareness and preparedness information from the Internet, Television 21%; 13% acquired from Family/Friends; Government Campaigns reveals 9%; 7% from Print Media, and 5% acquired from Radio.

Table 12. Descriptive Statistics of Acquired Earthquake Awareness and Preparedness Information.

Sources of Information	Number of Students
Television	32
Radio	11
Print Media	6
Internet	37
Government Campaigns	16
School/Office	31
Family/Friends	25

Table 12 displays the descriptive statistics of the acquired earthquake awareness and preparedness information, such as the source of information of second-year College of Science students at Bulacan State University. The number of students who acquired their awareness and preparedness information through television is 32. On the other hand, 11 students acquired awareness and preparedness information through Radio. Additionally, six students answered print media, and 37 answered the internet. Moreover, 16 students got information from the government campaign, while 31 got theirs from school or office. Lastly, 25 students acquired their source of information from their family or friends.

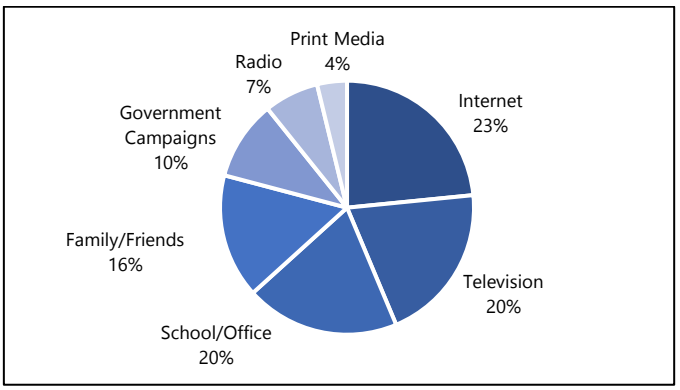

Figure 2. Pie chart of Acquired Earthquake Awareness and Preparedness Information.

Figure 2 shows the percentage of acquired awareness and information of the 40 second-year respondents, totaling 100%. The highest source, 23%, is acquired from the Internet; 20% acquired awareness and preparedness information from television and another 20% from School/Office, Family/Friends 16%; 10% from Government Campaigns, Radio reveals 7%; 4% from Print Media.

Table 13. Descriptive Statistics of Acquired Earthquake Awareness and Preparedness Information.

Sources of Information	Number of Students
Television	30
Radio	8
Print Media	12
Internet	37
Government Campaigns	8
School/Office	36
Family/Friends	15

Table 13 shows the descriptive statistics of acquired earthquake awareness and preparedness information, such as the source of information of third-year College of Science students at Bulacan State University. The number of students who acquired awareness and preparedness information through television is 30. On the other hand, eight students acquired awareness and preparedness information through Radio. Additionally, 12 students answered print media, and 37 answered the internet. Moreover, eight students got information from the government campaign, while 36 got theirs from school or

office. Lastly, the number of students whose source of information is their family or friends is 15.

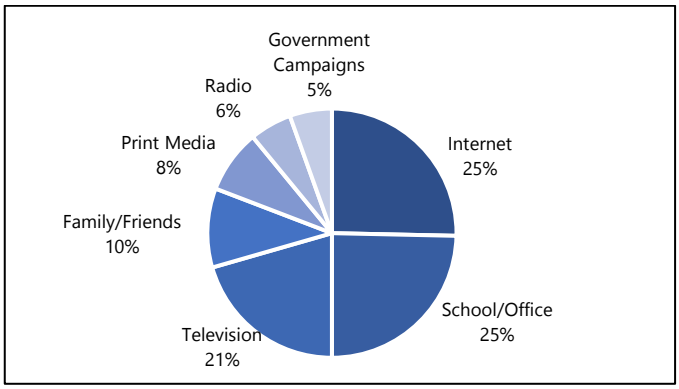

Figure 3. Pie chart of Acquired Earthquake Awareness and Preparedness Information.

Figure 3 displays the percentage of acquired awareness and information of the 40 third-year respondents with 100%. The highest source, with 25%, is acquired from the Internet and School/Office; 21% acquired awareness and preparedness information from Television, Family/Friends 10%, 8% acquired from Print Media, and Radio reveals 6%, and 5% from Government Campaigns.

Table 14. Descriptive Statistics of Acquired Earthquake Awareness and Preparedness Information.

Sources of Information	Number of Students
Television	32
Radio	6
Print Media	10
Internet	35
Government Campaigns	11
School/Office	32
Family/Friends	21

Table 14 reveals the descriptive statistics of acquired earthquake awareness and preparedness information, such as the source of information of fourth-year College of Science students at Bulacan State University. The number of students who acquired their awareness and preparedness information through television is 32. On the other hand, six students acquired awareness and preparedness information through Radio. Additionally, ten students answered print media, and 35 answered the internet. Moreover, 11 students got information from the government campaign, while 32 got theirs from school or office. Lastly, 21 students acquired their source of information from their family or friends.

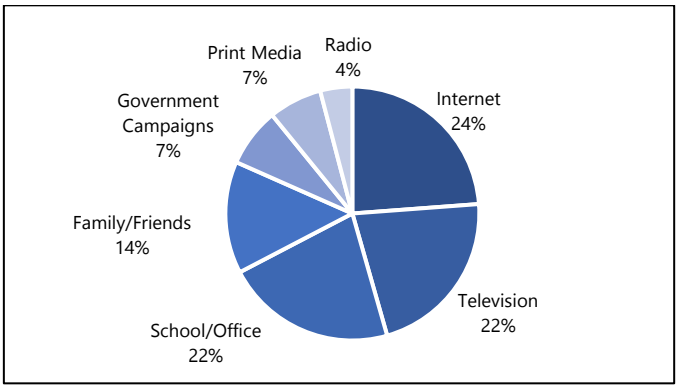

Figure 4. Pie chart of Acquired Earthquake Awareness and Preparedness Information.

Figure 4 illustrates the percentage of acquired awareness and information of the 40 fourth-year respondents, totaling 100%. The highest source with 24%, is acquired from the Internet; 22% acquired awareness and preparedness information from School/Office and another 22% from television, Family/Friends with 14%, 7% acquired from Print Media, Government Campaigns reveals 7%, and Radio with 4%.

Following the study conducted by in 2020, which revealed that television is the most widely used source of information in acquiring earthquake-related preparedness and awareness information, the results of the study also showed that television has a significant role in acquiring awareness and information among the College of Science students [28]. Moreover, the internet, which is being highly utilized by students nowadays, is also an essential source of earthquake awareness and preparedness information, given that it is incredibly accessible and convenient for disseminating data. It also involves the significance of Schools/Offices and Family/Friends in obtaining earthquake awareness and preparedness information. Meanwhile, acquiring information through Radio, print media, and government campaigns showed the lowest percentages from the survey results among the College of Science students.

4. Conclusion

The level of earthquake awareness and preparedness of the College of Science students at Bulacan State University about the possible movement of the MWVF was assessed in this study. Study findings showed that the respondents' earthquake public awareness level is high. However, first-year students showed a low level of awareness regarding the existing contingency plans for disaster risk reduction, while second-year students' awareness of the existing incident command system also revealed a low score. Nevertheless, the results show that all year levels know EEE. However, for risk reduction, all year levels are not highly

prepared for bolting and strapping house objects, and second-year students also showed a low-rating on-risk coordination management with their respective local government units. Overall, the results further showed that fourth-year students are highly aware of the potential movement of the MWVF among all the respondents, and first-year students have the highest level of preparedness. This implies that a high level of awareness in EEE does not signify a high level of preparedness for Risk Reduction.

Moreover, the researchers utilized the Kruskal Wallis Test through SPSS to determine if there is a significant difference between the awareness and preparedness of the four college year levels. The results showed no significant difference between their earthquake public awareness, environmental effects awareness, and disaster risk reduction preparedness. Nonetheless, since there is an evident result that the contingency plan awareness of first-year students is low, the assessment indicates that there was a significant difference. Another finding on the Kruskal Wallis Test is a significant difference in line with the respondents' participation in first-aid training for risk reduction and earthquake preparedness. The study's findings are similar to the study conducted by [29]; contingency plans, systematic response arrangement, proper information dissemination, and identified evacuation routes and sites are needed to develop and implement in response to earthquake disaster risk management.

Lastly, the first-year students acquired earthquake awareness and preparedness mainly from the School/Office. On the other hand, second- and fourth-year students acquired their awareness and preparedness mainly from the Internet. It can be inferred that the above sources influence the student's knowledge regarding earthquake awareness and preparedness. Overall, the results that were depicted in this study imply that the level of preparedness in terms of risk reduction and the individual response of the students within the College of Science is moderately low regardless of the outcome that the respondents have an adequately high level of public awareness and hazard awareness in relation with the potential movement of the MWVF.

5. Recommendations

The authors recommend that:

- Awareness regarding the Incident Command System and Contingency Plan should be expounded to the College of Science's first-year students at Bulacan State University.

For future researchers:

- A replication of this study, which includes other colleges in Bulacan State University, is to determine the student's level of awareness and preparedness on a larger scale.
- A comprehensive assessment of the factors influencing the level of awareness and preparedness in a study locale.
- The earthquake-related information provided by television, the Internet, and the school/office should be continued and improved because they strongly influence the student's level of awareness and preparedness.

Table 15, shown below, is the proposed intervention by the researchers to address and enhance the significant results shown in the study. The purpose of this action plan is to increase the level of earthquake awareness and preparedness among the College of Science students at Bulacan State University. It outlines the optimal objectives, individuals involved, the tasks and activities to be implemented, and a designated time frame for each activity.

The first program initiative is to conduct an Incident Command System (ICS) Awareness Seminar once every academic year to highlight the importance and function of the existing Incident Command System during a natural disaster in the university. The invited participants will involve the Second-Year students from the College of Science, considering that they had a low level of awareness about the ICS from the study results. The seminar will provide them with adequate systematic information about efficient disaster or emergency management and response. Subsequently, ICS-related leaflets will be distributed to the seminar participants to provide them with more organized and detailed information about the ICS.

Another seminar will also be administered to deal with the existing Contingency Plan at the university. The seminar is to be attended by the First-Year students in the College of Science once every academic year as they revealed a low level of awareness about the Contingency Plan. Leaflets will also be disseminated containing critical information that entails emergency preparedness about the procedures to be followed in the Contingency Plan.

Disaster Risk Reduction Management Activities were also proposed, including the provision of first-aid training, aiming to explain its importance and function to help the students be prepared before an earthquake strikes and raise awareness regarding the do's and don'ts during and after an earthquake. This proposed plan is expected to involve all the students from the College of Science and be provided with training materials and manuals, instructional audio/video presentations, and photographic briefs, which will take place once every academic year. It will further give the students DRR strategies such as evacuation plans, first aid, and search and rescue techniques.

Table 15. Research Output: Proposed Intervention for the College of Science Students

Programs	Objectives	Involved Individuals	Plan and the task of activities	Time Frame
Incident Command System Awareness Seminar	● To explain the existing Incident Command System. ● To explain the function of the Incident Command System. ● To consider various recommendations from the students.	Second-Year College of Science Students in Bulacan State University.	● Seminars. ● Distribution of ICS-related leaflets.	Once Every Academic Year
Contingency Plan	To explain the existing Contingency Plan and its function in the university and community.	First-Year College of Science Students in Bulacan State University.	● Seminar. ● Distribution of leaflets with contingency plan information.	Once Every Academic Year
Disaster Risk Reduction Management	● To explain Disaster Risk Reduction Management. ● To explain the function of Disaster Risk Reduction Management. ● To help students to prepare before an earthquake strikes. ● To raise awareness regarding the do's and don'ts during and after an earthquake. ● To provide an all-inclusive first-aid training response.	All Year Level of College of Science Students in Bulacan State University.	● Training materials, manuals. ● Instructional Audio /Video presentations. ● Photographic briefs.	Once Every Academic Year

*The proposed action plan may change depending on the available resources.

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References

[1] X. Fan, "Earthquake-Induced Chains of Geologic Hazards," in *AGU Fall Meeting Abstracts*, 2019, vol. 2019, pp. EP53B-02.

[2] N. Hovius *et al.*, "Prolonged seismically induced erosion and the mass balance of a large earthquake," *Earth Planet. Sci. Lett.*, vol. 304, no. 3–4, pp. 347–355, 2011.

[3] P. Meunier, N. Hovius, and J. A. Haines, "Topographic site effects and the location of earthquake induced landslides," *Earth Planet. Sci. Lett.*, vol. 275, no. 3–4, pp. 221–232, 2008.

[4] F. C. Dai, C. Xu, X. Yao, L. Xu, X. Bin Tu, and Q. M. Gong, "Spatial distribution of landslides triggered by the 2008 Ms 8.0 Wenchuan earthquake, China," *J. Asian Earth Sci.*, vol. 40, no. 4, pp. 883–895, 2011.

[5] L. G. Ipong, E. E. Ongy, and M. C. Bales, "Impact of magnitude 6.5 earthquake on the lives and livelihoods of affected communities: The case of barangay lake Danao, Ormoc city, Leyte, Philippines," *Int. J. disaster risk Reduct.*, vol. 46, p. 101520, 2020.

[6] A. K. Mehta and A. Shah, "Chronic poverty in India: Incidence, causes and policies," *World Dev.*, vol. 31, no. 3, pp. 491–511, 2003.

[7] M. Masozera, M. Bailey, and C. Kerchner, "Distribution of impacts of natural disasters across income groups: A case study of New Orleans," *Ecol. Econ.*, vol. 63, no. 2–3, pp. 299–306, 2007.

[8] M. R. Carter, P. D. Little, T. Mogues, and W. Negatu, "Poverty traps and natural disasters in Ethiopia and Honduras," *World Dev.*, vol. 35, no. 5, pp. 835–856, 2007.

[9] M. Masum and M. A. Akbar, "The Pacific ring of fire is working as a home country of geothermal resources in the world," in *IOP Conference Series: Earth and Environmental Science*, 2019, vol. 249, no. 1, p. 12020.

[10] D. Zhao, "Seismic imaging of Northwest Pacific and East Asia: New insight into volcanism, seismogenesis and geodynamics," *Earth-Science Rev.*, vol. 214, p. 103507, 2021.

[11] J. Lei, F. Xie, Q. Fan, and M. Santosh, "Seismic imaging of the deep structure under the Chinese volcanoes: An

overview," *Phys. Earth Planet. Inter.*, vol. 224, pp. 104–123, 2013.

[12] C. Wilke, "Scientists Say: Ring of Fire," Science News Explores," *www.snexplores.org*, 2020. https://www.snexplores.org/article/scientists-say-ring-of-fire. (accessed Oct. 18, 2023).

[13] I. Rusydy *et al.*, "A GIS-based earthquake damage prediction in different earthquake models: a case study at the University of the Philippines Los Baños, Philippines," *Philipp. J. Sci.*, vol. 147, no. 2, pp. 301–316, 2018.

[14] P. J. D. Reyes, M. A. V Bornas, D. Dominey-Howes, A. C. Pidlaoan, C. R. Magill, and R. U. Solidum Jr, "A synthesis and review of historical eruptions at Taal Volcano, Southern Luzon, Philippines," *Earth-science Rev.*, vol. 177, pp. 565–588, 2018.

[15] C. G. Newhall, "Temporal variation in the lavas of Mayon volcano, Philippines," *J. Volcanol. Geotherm. Res.*, vol. 6, no. 1–2, pp. 61–83, 1979.

[16] L. G. Mastin and J. B. Witter, "The hazards of eruptions through lakes and seawater," *J. Volcanol. Geotherm. Res.*, vol. 97, no. 1–4, pp. 195–214, 2000.

[17] M. C. Quigley *et al.*, "The 2010–2011 Canterbury earthquake sequence: Environmental effects, seismic triggering thresholds and geologic legacy," *Tectonophysics*, vol. 672, pp. 228–274, 2016.

[18] G. R. Foulger, M. P. Wilson, J. G. Gluyas, B. R. Julian, and R. J. Davies, "Global review of human-induced earthquakes," *Earth-Science Rev.*, vol. 178, pp. 438–514, 2018.

[19] J. P. McCalpin and A. R. Nelson, "Introduction to paleoseismology," *International Geophysics*, vol. 62. Elsevier, pp. 1–32, 1996.

[20] A. K. S. Ong *et al.*, "Factors affecting intention to prepare for mitigation of 'the big one' earthquake in the Philippines: Integrating protection motivation theory and extended theory of planned behavior," *Int. J. Disaster Risk Reduct.*, vol. 63, p. 102467, 2021.

[21] T. Allen *et al.*, "Enhancing risk analysis capacities for flood, tropical cyclone severe wind and earthquake for the greater metro manila area," *Philipp. Inst. Volcanol. Seismol. Geosci. Aust.*, 2014.

[22] J. A. Carteciano, "The Big One Part 2 (Review of The Big One Part 2)," *Research Council of the Philippines*, 2017. https://nrcp.dost.gov.ph/feature-articles/279-the-big-one-part-. (accessed Oct. 09, 2023).

[23] A. J. Topacio, A. E. P. Ramos, J. E. Villaester, and J. C. A. Pacamparra, "Comparative Study of Potential Liquefaction of Three Selected Locations along the Pasig City Segment of the Valley Fault System, Philippines."

[24] J. L. Hanson, D. F. Balmer, and A. P. Giardino, "Qualitative research methods for medical educators," *Acad. Pediatr.*, vol. 11, no. 5, pp. 375–386, 2011.

[25] J. G. Wacker, "A definition of theory: research guidelines for different theory-building research methods in operations management," *J. Oper. Manag.*, vol. 16, no. 4, pp. 361–385, 1998.

[26] T. W. Edgar and D. O. Manz, *Research methods for cyber security*. Syngress, 2017.

[27] H. Taherdoost, "Sampling methods in research methodology; how to choose a sampling technique for research," *How to choose a Sampl. Tech. Res. (April 10, 2016)*, 2016.

[28] J. D. Quebral *et al.*, "A comparison of the levels of earthquake awareness and preparedness in a high risk and low risk barangay," *Heal. Sci. J.*, vol. 9, no. 2, p. 1, 2020.

[29] T. Thromde, "Bhutan: Thimphu Thromde Earthquake Contingency Plan," *www.preventionweb.net*, 2016. https://www.preventionweb.net/files/61893_thimphuthromdeearthquakecontingency.pdf (accessed May 12, 2023).